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# DIPHThERIA

## AND ITS TREATMENT.

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### HISTORY.

Diphtheria is not a new disease. It is thought to have been familiar to the ancient Greeks, Romans and Egyptians. It probably prevailed, more or less, under various names, during the first fifteen centuries of the Christian era. Hippocrates, 460 years before Christ, describes the disease. Aretæus, who lived at the close of the first and the beginning of the second centuries, wrote very extensively upon diphtheria. Aretæus says that children who have not arrived at the age of puberty were the most frequently attacked by this disease. The fœtor which came from the mouths of the fatal cases is spoken of as being very loathsome. Fluids were regurgitated through the nose, and there was hoarseness and loss of voice. In some cases the disease extended to the air tubes and caused speedy death by suffocation. The disease, as thus described by Aretæus, originated in Egypt, and especially Coelo, Syria, whence it was described by the name of *malum Egyptiacum*, or Syrian ulcerations. Macrobius speaks of an epidemic of diphtheria at Rome, A. D. 380, at which time sacrifices were offered up to a certain goddess. During the first 500 years the disease extended only into Asia Minor. It then invaded the South of Europe, and

crossing the continent during the next 1,500 years, affecting principally garrisoned towns, till, reaching Paris, London and Liverpool, it passed to various other parts of the world. It is known to have been epidemic in Western Europe in the sixteenth, seventeenth and eighteenth centuries. In 1337, a fatal epidemic of diphtheria occurred in Holland, and again in 1557, which proved very fatal, and which spread to other parts of Europe. In 1576, there was a very malignant form of the disease prevalent in Paris, and from that time we find that epidemics of diphtheria have shown themselves almost constantly to a greater or less extent, in some portions of Europe. In 1820, diphtheria was epidemic in the South of France, and the first accurate investigations concerning the nature of the disease were made by Bretonneau, in the year 1821.\*

Bretonneau gave the disease the name of diphtheria, from the characteristic fibrinous exudation which accompanies it.†

In 1855, diphtheria became an epidemic in England. It was brought by an English ship from Bologne, where it was epidemic, and it was called diphtheria, or Bologne fever. Diphtheria, at that time, was clinically an unknown disease to most practising physicians in England. The epidemic was investigated by the medical department of the Privy Council, and pronounced contagious, although it was thought by them that the disease moved from place to place, independently of the direct mediation of persons or clothing, and apparently through the air.

Dr. Douglass, of Boston, in the year 1736, seems to have published an account of the first appearance of the disease in this country. The epidemic which he describes was very malignant. Since the epidemic described by Dr. Douglass we do not find any other of a similar character mentioned by writers until 1831. The disease has been more or less preva-

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\* *Traité de la Diphthérie.* Paris, 1828.

† The epidemic which raged in France in 1828, has been graphically described by Professor Trousseau. At Marcilly more than one tenth of the entire population had died of the disease. In one family of eighteen persons all but two died.

lent in this country ever since. In California, especially, very fatal epidemics have prevailed. In 1858, in Albany, New York, diphtheria assumed an epidemic character, proving very destructive. In a population of 60,000 there were 167 deaths.

In New York, consumption, dysentery and pneumonia still take the lead in the order named, in the number of deaths, but diphtheria follows closely upon these, and is likely to eclipse them all, since science is ever gaining added control over the three most deadly ailments known in this latitude, while diphtheria steadily increases in malignancy and in the power to destroy. In the year 1857, in the city of New York, there were two deaths reported from diphtheria; in 1858, there were five; in 1859, fifty-three; in 1860, four hundred and twenty-two; in 1861, four hundred and fifty-two; in 1862, five hundred and ninety-four. In 1873, there were 1,151 deaths, while in 1874, the number was increased to 1,672, and in 1876, reached the number of 3,510. In London, with three times the population, the yearly mortality from this disease has never exceeded five hundred.

Dr. William Farr calls attention to the fact that of 1,000 children born, 4.9 die of diphtheria in the whole of England and Wales; 4.4 in Liverpool, and so many as 10.3 in the healthy districts of England and Wales, which are exclusively rural. In England, in 1860, there were 5,212 cases; in 1861, 6,810; in 1862, 6,975 deaths reported from this disease alone.

In Massachusetts, diphtheria has recently prevailed with great malignancy in the northern and western parts of the State, where the population is largely American, the land high but often moist, and drainage almost entirely left to nature. In Williamstown and Adams, the epidemic fell heavily. Following down the valley of the Deerfield river, Florida, Heath, Charlemont, Leyden, Shelburne, Conway, Greenfield, Deerfield and Bernardston suffered severely. The mortality in some of these towns was excessive, reaching in some towns as high as 75 per cent. In Conway, where there is a large Irish population, the Americans were almost the only ones attacked, and one-tenth of the native population suffered from the disease, of whom thirty per cent. died.

The present epidemic has reached a considerable degree of severity in parts of France, Italy, Germany, Russia and Austria. In the United States, California, New York, Vermont and Tennessee have suffered severely, showing the wide extent of its prevalence. Occasionally it has come suddenly and as suddenly disappeared; elsewhere there have been several recurrent epidemics, and in towns where the sanitary condition is very bad, it has become virtually endemic. The principal errors in statistics are due to the lack of common agreement between physicians as to the application of the terms diphtheria and croup, and the confounding of scarlet fever, in some of its forms, with the former. In Meriden, a case of œdema of the glottis in a man 36 years old, was returned as diphtheria.

The mortality from diphtheria is high. Oertel puts it, in severe epidemics, at 30 and 40 per cent.; English authorities, from 10 to 33 per cent. In Massachusetts, the death rate from it ranged from 6 to 80 per cent. of the cases attacked, and in some localized epidemics every person attacked has died. Trousseau reports an epidemic where, of sixty persons attacked, nearly every one died.

#### CAUSES.

Diphtheria must be placed in the same category with small-pox, scarlet fever, measles and other zymotic affections. Like them it is due to a specific virus. It is both contagious and infectious, although the exact mode in which the contagion operates is unknown; but the contagion clings to particular places, houses, and even chambers. Diphtheria is not, however, contagious in the same sense that scarlet fever and measles, for instance, are so, for it does not prevail in densely-populated places, where the facilities for contagion are best. As the distance to which scarlet fever is transmissible is less than in the case of measles, so does it appear that nearer contact is necessary in propagating diphtheria than the other contagious diseases. It is believed by many that diphtheria is inoculable. Dr. Valleix, well known as a writer on the diseases of children, was attending a child with diphtheria. One day, on examining the throat of his patient, he

received in his mouth a little saliva, ejected in the effort of coughing. In forty-eight hours Dr. Valleix died of diphtheria, though his patient recovered.

M. Brettonneau relates the case of a boy affected with frost-bites on his foot, happening to use a bath that had been employed for a diphtheritic patient; his great toe at once became the seat of painful diphtheritic exudation. On the other hand, Professor Trousseau failed in experiments, which had in view the inoculation of himself and two of his pupils with diphtheritic matter.

In my own practice, a girl thirteen years old had a very severe attack of diphtheria, keeping her in bed about two weeks. Three months after recovery she visited another town, and occupied the same bed with a sister eleven years old, and this sister was attacked with diphtheria and died. Another instance was a lady, two weeks after having had diphtheria in her family, visiting another town, and a young child in the family she was visiting, was attacked with the disease and died, it being the only case in the town at that time. It would seem that there must be a condition of system favorable to the development of diphtheria; otherwise, we can hardly account for the immunity of certain families, or certain individuals, when subjected to conditions apparently identical with those which have been followed by the development of diphtheria in other members of the family, or in other inmates of the household. The more virulent a case of diphtheria and the more abundant the secretions, the greater the liability to infection. Virulent cases, however, may result from infection originating from mild cases. The idea is fast gaining ground that diphtheria, when not communicated from person to person, is generally, if not always, due to unsanitary local conditions. It may be developed from foul, stagnant water, from defective drainage-pipes, permitting soil saturation with the unwholesome fluids that should be conducted safely away; or, as is too frequently the case, from cheap and defective plumbing, without proper traps and devices for preventing the intrusion of noxious sewer-gas into the sleeping apartments and living rooms of

dwellings. The statement of Mr. Simon, chief sanitary officer of Great Britain, is a rather startling one to consider. He says that of 1,000,000 deaths occurring in England, fully 125,000 are from preventable diseases. The English town of Croyden was very unhealthful at one time; so much so, in fact, as to lead to the establishment of a pretty complete set of public works, and the enforcement of special sanitary regulations, all of which have been in operation some eighteen years. The mortality before the completion of the works was 23 per 1,000. Afterwards it was 18 per 1,000 for an average of thirteen years. This gain of five per cent. represents about 2,500 lives.

In low and damp, or high and damp places, especially in narrow river valleys running easterly and westerly, with shallow or clay soils, especially if overlying rock, and with polluted air and wells, the fatality from diphtheria has often been such as to remind us of the plagues of the last century. It is clearly demonstrable that, as the drainage of a district is perfect or imperfect, so certain forms of disease disappear or prevail. Typhoid fever, epidemic influenza, scarlet fever, as well as diphtheria and other diseases, are generated or aggravated by the neglect of the most important of sanitary measures—a perfect system of sewerage. No water-soaked ground can ever be healthy, or fit for human habitation. Soil moisture is well known to be one of the prolific causes of the tubercular diseases which annually claim tens of thousands of victims. Dwellings, otherwise excellent, are often erected in apparent utter thoughtlessness of the character of the soil on which they are built, or its capacity for drainage, where this should have been a primary consideration. When the people have once been educated to an appreciation of the fact that a homestead built on undrained soil is the certain abode of death; that houses with their water supply and and privy vault in close proximity, are nothing less than highwaymen who watch for our lives; when they are convinced that certain conditions, either of soil or dwelling, will certainly produce death, then will they begin to understand and appreciate the importance of a thorough system of drain-

age, as well as the proper arrangement of the water supply of their dwellings.

#### NATURE AND PATHOLOGY.

One of the most interesting medical questions of the day is that relating to the connection between certain minute organisms and diseases, and it forms the basis of one of the most complete theories that has ever been advanced to account for the origin and spread of certain diseases. Researches of recent date have shown conclusively that foul drinking-water and the exhalations from privies and sewers, or their connections, are the principal agencies by which typhoid fever is spread. We know that some diseases at least are due to minute animals, such, for example, as itch and trichinosis, and that favus and perhaps a large number of other skin diseases, are due to a microscopic plant. Until recent years the majority of opinion has been unfavorable to this germ theory as it is called, until the researches of Chaveau,\* Sanderson,† Bastian,‡ Panum,|| Billroth§ and Hiller¶ came to be generally known to the profession. All of these observers admit that certain diseases are associated in their lesions with the presence of low organisms. All of these organisms are of microscopic size—some, indeed, so minute that it requires the highest powers of the microscope in common use to make them out with any degree of distinctness. These bodies have recently come to be called bacteria,\*\* but they are not all rod-shaped as the name would imply. Bacteria are found very abundantly in all putrid fluids and substances, with very rare, if any, exceptions; but they are by no means confined to such conditions,

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\* Twelfth Report of the Medical Officer of the Privy Council, 1869, p. 232.

† British Medical Journal, January 16, February 13, March 27, April 3, 1875.

‡ London Lancet, April 10, 1875.

|| Virchow's Archiv., IX, III, IV, 1874.

§ Untersuchungen ueber die veg. formen von Cocc bacteria septica, Berlin, 1874.

¶ Archiv. fur Klin Chir. IV, 1875, et al.

\*\* Bacterium, a little rod.

as they exist generally in nature, and in fact in the very air we breathe. This has been clearly demonstrated by Professor Tyndall.

These remain innocuous, and can be found in the saliva of healthy persons by microscopical examination. Professor Dalton has shown that they multiply one million times in less than an hour. Diphtheria is one of the three diseases in which bacteria have been found. No one had the faintest idea regarding the true causation of diphtheria until Hueter and Oertel in Germany simultaneously made the discovery that the diphtheritic membranes, the subjacent diseased parts, and even the blood of diphtheritic patients contained in great numbers these vegetable organisms, so-called bacteria.

There is one form of bacteria, according to Oertel, which in particular penetrates the tissues wherever the diphtheritic disease is found. The bacteria, to which allusion is here made, are spherical in form, and are called by Oertel micrococci. Oertel found the exudation and tissues filled with these parasites, and the more severe the type of the disease, the more numerous were the bacteria. Whenever the disease increased in severity, there was also a corresponding increase in the number of these vegetable organisms in the infected parts. At the very commencement of the disease, before the exudation takes place and the false membrane forms, the bacteria are present; they spread themselves over the membrane, work their way down between the cells of the epithelial layer, and derange the anatomical relation of those cells by forcing them from their proper places; they find their way into blood and lymph vessels, and mechanically dam up those vessels, thereby deranging nutrition, causing an exudation of serum and rupture of the walls of the capillary vessels. Oertel says: "I believe I have proved, by a series of experiments, that diphtheria begins as a local disease, and develops afterward into a general one; and that, moreover, the general infection is kept up by the local one." Dr. Austin Flint\* regards diphtheria as a constitutional disease, and

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\*Theory and Practice of Medicine.

the diphtheritic affection as the local expression of a special morbid condition of the system. He is not definite as to the active agent by which the disease is brought into being; in other words, as to the exciting cause of the disease. Niemeyer says:† “Diphtheria belongs among the infectious diseases, and even among those that are most typically contagious. The miasmatic origin of the disease is doubtful.” Niemeyer does not tell us how the disease is brought about. Professor Delafield, of New York, considers diphtheria as a compound disease, like epidemic influenza, cerebro-spinal meningitis, and a few others, made up in its pathology of an essential fever and a local inflammation. Dr. J. Lewis Smith says:‡ “The specific principle of diphtheria, in all probability, enters the blood in ordinary cases through the lungs; and after an incubative period, which varies from a few hours to seven or eight days, produces the symptoms which characterize the disease.” Dr. Thoersen, of Christiana, Norway, says in an article on the nature of diphtheria, published in 1866: “My opinion is that the disorder is a primary blood disease, and the diphtheritic exudation is nothing but a casting from the surface of the affected tissue, which through the impression of the poison, has suffered such changes as belongs to an ordinary gangrenous process. The deeper and more intense the impression made by the poison, the more has to be cast off, and the thicker the patches must necessarily be.” To us it appears that the first changes are manifested in the blood, and from these the nervous centers are deprived of their proper support. The morbid alteration of the blood may be brought about by the contagion of the poison which produces the poison itself, and therefore we may view them as the cause, and the changes which they produce as the results of this morbid impression upon the vital fluid.

These poisons effect a deprivation of the circulating fluid by the introduction of matter from without, which acts as a ferment, exciting chemical changes in the constitution of the blood, so that its whole character is changed and its vital

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† Theory and Practice of Medicine.

‡ American Journal of Medical Sciences, October, 1877.

properties diminished. The severity of the disease depends upon the degree of this morbid impression and the extent of the changes which the blood has undergone. If the disease was of an inflammatory class, we should observe very different changes of a constitutional nature from those which have fallen under our notice. The treatment which is appropriate for inflammation, fails entirely in diphtheria. The membranous deposit comes from the depraved or changed condition of the blood, trying to eliminate the morbid poison.

#### DIPHTHERIA AND CROUP.

In 1765, Dr. Home, of England, first introduced the term croup into medical literature. He first drew attention to the fact that the formation of a false membrane in the trachea and larynx is essential to the disease, and constitutes the source of danger. Dr. Home's description of croup was not only accepted by most of the physicians of England, but also by many in Europe.

The term croup, however, is a most unfortunate one; for in the first place it has left confusion in the minds of the people, who frequently do not distinguish between the false form, or spasmodic laryngitis, and the membranous form; and it has also been a source of confusion to the profession, for the term croupous, as opposed to diphtheritic, has at one time been used to describe a clinical difference, and at another an anatomical one.

The majority of practitioners, at the present day, believe in the identity of croup and diphtheria; but a very respectable and equally intelligent minority are unable to support this opinion. There is no doubt that many advocates of the existence of true croup include undoubted cases of diphtheria in their category; while cases of supposed croup, on the other hand, are included in the categories of those of the contrary opinion. Hence much of the existing confusion as to what is a case of diphtheria, and what a case of croup. If we are willing to admit, as I think we safely can, that a patient with diphtheria may contract croup, and a patient with croup may contract diphtheria, this obscurity disappears in part. It has been alleged that the clinical histories of

diphtheria and croup are very different. So, too, is the clinical history of malignant pustule very different from that of carbuncular fever. No one, however, would infer that they were nosologically distinct. It is, on the contrary, universally recognized that these two affections are but separate manifestations of one and the same disease, which may be associated, succeed each other, or exist alone. With Bretonneau, nearly all French writers regard croup and diphtheria as identical. Since the time of Bretonneau, an abundance of clinical facts have been collected, which have been used by writers to show that there is a marked contrast between the two diseases. Virchow made the apparent differences more striking by emphasizing the fact, as he stated it, that in croup the exudation lay upon the surface of the laryngeal mucous membrane, while in diphtheria it not only covered the surface, but actually invaded the mucous membrane itself, and subsequently, from lack of nourishment, the membrane was apt to become necrotic. Wagner, on the other hand, claimed that there was no such sharp anatomical distinction between the two exudations, and they were only alike in that the exudation of croup was confined to the throat, while in diphtheria it involved the other air passages. Oertel\* holds that the separation of the two diseases—membranous croup and diphtheria based on anatomical and pathological grounds—is impossible, for in the severest forms of diphtheria, such as those that are followed by extensive paralysis, the so-called croupous exudations have been found lying freely on the surface of the mucous membrane. He says that in the early stages, a certain diagnosis will be impossible.

It is certain, as I have seen it in my own experience, that under the same endemic and epidemic influences, a case of catarrh, a case of croup, a case of diphtheria, and a case of follicular inflammation of the tonsils, may appear in the same family, and in the same week, and that catarrh on the one side and diphtheria on the other, are but the starting and terminating points between which all the different shapes and forms may be registered according to their dignity, their

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\* Ziemssen's Cyclopædia.

modification depending on individual, local, endemic and epidemic influences. In the February number, 1871, of Virchow's Archives, Dr. Franz Hartman advocates the idea that croup and diphtheria are not distinct diseases, but different grades of one and the same process. Croup, therefore, indicates the existence of inflammation not so severe as that which gives rise to diphtheria, and affects more frequently the larynx than the pharynx, because the mucous membrane of the latter is of much looser texture than that of the former. From our present standpoint, whenever we find an idiopathic membranous inflammation of the larynx, it seems proper to regard it as a case of diphtheria. It certainly would be rash to allow the precautions considered necessary in cases of diphtheria to be neglected.

#### DIPHTHERIA AND SCARLET FEVER.

The exact relation which exists between diphtheria and scarlet fever has been a much debated question. By some persons the two affections, notwithstanding certain points of strong resemblance, are regarded as essentially different. By others, diphtheria is regarded as a form of scarlet fever, in which the throat affection is unaccompanied by the eruption which usually characterizes it. It is very evident that there is some intimate relationship existing between the diseases in question; one so glides into the other that we have the singular instance of two disorders, generally described as distinctly separate, existing at the same time.

Dr. Anderson, of England, who has given considerable attention to this subject, remarks that in every case of diphtheria he has seen, he has been able to trace the actual presence of scarlet fever in the house or in the immediate neighborhood.

I have had under my care in the same family, at one time, two or three well-marked cases of scarlatina, and also several as well-defined cases of diphtheria, all children, and each disease running its definite course without conflicting with the other. In volume second of Ziemssen's Cyclopædia, a work containing the cream of German medical literature, Professor Thomas says that diphtheria can be a complication of the

mildest as well as the severest forms of scarlatinous throat affections. After scarlatina has already existed for several days, the throat symptoms suddenly become aggravated by the occurrence of diphtheria. In like manner scarlatina may, at any time, complicate diphtheria. The sequelæ following scarlatina are dropsy, albuminuria, otorrhœa, diarrhœa, rheumatism, swelling of the cervical glands, followed by abscess, endocarditis, paralysis, heart clot, impairment of vision, deafness, aphasia. Precisely the same sequelæ follow diphtheria. I have seen every one of the sequelæ I have named follow both diseases. It is evident, however, that the two diseases are distinct, and yet that some very definite and close connection exists between them. It is not easy to point out wherein the bond consists; but it is possible that the relations of some other ferments may throw some light on the subject.

#### SYMPTOMS AND COURSE OF DIPHTHERIA.

Previous to an epidemic of diphtheria other throat affections are usually prevalent, such as tonsillitis, ulcerated sore throat, etc. As in other zymotic diseases, the symptoms vary greatly in intensity in different cases, so much so that some writers have instituted several varieties of the disease. As a general thing, diphtheria is more severe and fatal, and its symptoms more violent in the beginning, than when the epidemic influence is passing off. The chosen subjects of the disease are those in whom there exists some constitutional cachexia—the weakly, the scrofulous, the offspring of sickly and delicate parents and bottle-fed infants, and all those where the morbid condition is dependent upon defective assimilation and sanguification, rendering the blood deficient in organic and nutritious matters. Persons of all ages are liable to the disease, but it is much more frequent in children between the period of weaning and the tenth year of life, than in adolescents and adults. It seldom attacks individuals in absolutely first-rate health, while living under good hygienic influences, unless they have been more or less directly exposed to contagion from contact with a diphtheritic patient, or with emanations from his body, whether contained

in clothing, utensils, excretæ, or the exudation itself. The period of incubation, or the period intervening between exposure to the infection and the manifestation of the disease, varies from two to fourteen days. A marked point of difference relates to the development of the disease. A mild commencement frequently ushers in a fatal form of the disease. In fact, the initiatory symptoms have no definite relation to the future severity of the disease, or to the parts which are to be the seat of the inflammatory exudation. There is usually a degree of chilliness, with rigors, often slight, succeeded by more or less fever, headache, languor, and loss of appetite. I have noticed in a number of instances that the day before the lassitude appeared, the child was in the best possible health, and that the mother or nurse said that they had never known the little one to feel and appear so well. Pain in the ear is mentioned by Bretonneau as an early symptom in one of his cases,\* and by Dr. L. N. Beardsley, of Milford, Conn., as the first symptom in almost all the cases he saw in an epidemic; occurring a day or two before any other complaint was made, and before any evidence of exudation could be detected in the throat.

In cases in which the initiatory febrile condition exists, there is elevation of the body temperature, greater at night than during the day time. Marked elevation of temperature is usually indicative of severity, heralding a case in which the local manifestation is likely to extend to the respiratory tract. A more moderate increase of temperature, on the contrary, is by no means indicative of a milder form of the affection, or less liability of this extension of the exudation. The temperature often rises to  $105^{\circ}$ – $107^{\circ}$ , although in the majority of cases it is less than in scarlet fever. Bleeding from the nose is a common symptom and indicative of blood change. Sometimes the disease begins with a convulsion—or there may be several—indicating cerebral complication. The pulse is full and abnormally frequent, and usually unassociated with corresponding increase of the number of respirations. Aside from frequency, the pulse is soft or compressible, not denot-

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\* *Memoirs on Diphtheria*: Sydenham Soc., London, 1859, p. 201.

ing augmented power of the heart's action. In mild cases it may not exceed 100. Usually it is 120–130, and in the malignant form frequently reaches 140. Stupor is a prominent symptom in bad cases during the first day or two, and it is a most unfavorable sign. It is not yet known whether coma and convulsions, occurring in this disease, are due to uræmia.

Restlessness is always an alarming symptom, as indicating irritation of the brain and nervous centers from poisoned blood. It is the surest criterion of the amount of poison in the system, and where it is extreme and persistent throughout, the disease generally points to a fatal termination. The tongue, though moist in some cases, is frequently covered with a thick, dry coating. The desire for food is either notably diminished or lost. The disease has no characteristic eruption, although an efflorescence is sometimes observed upon the surface when the temperature of the skin is raised. The rash does not differ from ordinary erythema, so common in the febrile and inflammatory affections of infancy and early childhood. Diarrhœa is not uncommon, and is a symptom of bad omen. An early symptom is nausea and vomiting, which may continue for hours or even throughout the sickness. This is evidently due to congestion of the brain and is the result of reflex action. The urine is scanty, of high specific gravity, and acid in reaction, with increase of urea; microscopic examination usually affording evidence of tube casts, and, in occasional instances, of blood-corpuscles; while uric acid, the urates, oxalates, and sometimes phosphates are to be detected in the sediment. The most interesting and important change, however, in the constitution of the urine is the occurrence of albumen in it. This element was first discovered by Dr. Wade, of Birmingham, England, in 1857.\* Shortly after this, during the researches on this disease at Paris, MM. Bouchut and Empis made a similar discovery. Albuminuria did not exist in every case examined, but it was seen in twelve out of fifteen cases. Both of these observers attach great importance to this renal complication, as affording an anatomical explanation of the cause of death,

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\* Observations on Diphtheria, by W. F. Wade, B. A. etc., 1858.

when this can not be attributed to either of the other modes, viz., asphyxia or general poisoning. In forty-eight cases studied by Professor Flint, of New York, albumen was found in nineteen. The presence of albumen does not seem to depend upon a blood poison, but upon pathological changes which take place in the kidneys themselves; and these changes may, according to Oertel, without difficulty, be traced to the action of bacteria. In those cases which have terminated fatally in consequence of blood poisoning, the kidneys were found to be lividly congested, the cortex and medulla deeply reddened, and in color hardly distinguishable the one from the other. While on the other hand, in the cases in which the patients, especially children, have died by suffocation, the kidneys were found but slightly affected. Bacteria are found in all the kidneys in which pathological changes have taken place as a result of diphtheria. Albumen usually appears early; sometimes it is noticed about the time of the onset of the laryngeal symptoms, sometimes not until a later period, even as late as the second or third week. The quantity often varies greatly from day to day, sometimes amounting to from one to two or three drachms in twenty-four hours; and although it usually remains throughout the disease, it may disappear and reappear again and again, its traces gradually becoming fainter during convalescence. The course of diphtheria lacks uniformity in fatal not less than in favorable cases. In fatal cases the duration may fall short of a week, death sometimes taking place within forty-eight hours. On the other hand, the illness may continue for an indefinite period beyond the maximum duration of the career of the disease, owing to consecutive affections or sequels. During the first week of the disease, in cases not directly fatal from innervation or collapse, the danger is from the larynx, and if the larynx remains unaffected, the danger then lies in the exhaustion and deficiency of nerve force or energy; conditions which may ensue even in connection with but a trifling amount of inflammation and exudation in the throat. Tumefaction of submastoids, submaxillary, and cervical glands is regarded as proportionately indicative of the severity of the

case. During all epidemics of diphtheria there are many cases which are inevitably fatal from the beginning, the system having received such an overcharge of the poison as to render all human efforts unavailing. Physicians are more frequently deceived by the prognostic signs in diphtheria than in almost any other disease. I have known physicians to give a favorable prognosis, while death occurred from some unseen or unsuspected cause. The character of the epidemic, the hygienic conditions by which the patient is surrounded, and the opportunity that may exist for improving those hygienic conditions, all exert more or less influence on the general prognosis. Intense pharyngitis, an extensive pseudomembrane, and cervical cellulitis and adenitis, indicate a form of the disease, which usually proves fatal in the robust, as well as the weakly. When the inflammation extends to the larynx, and the phenomena of croup arise, there is slight prospect of recovery.

Dr. J. Lewis Smith says:\* "When the croupy cough, voice, and expiration are observed, he will seldom err, who predicts a fatal result within a week, and often death follows in two or three days." This, however, has not been my experience. In many cases, after the active symptoms have somewhat abated, the result for days or even weeks is uncertain on account of the anæmia. Mild cases in which there is but little deposit, may prove fatal by blood-poisoning, or by collapse before the local manifestation has become fully developed. Nasal diphtheria is a very grave complication. Death in diphtheria may result from: 1, Diphtheritic blood-poisoning. 2, From septic blood-poisoning, produced by absorption from the under surface of the decomposing pseudomembrane. 3, From an invasion of the larynx. Professor Flint says:† "Of the cases in which the air-passages become involved, the vast majority end fatally." The danger from this source progressively diminishes after the first week. 4, Uræmia. 5, Sudden failure of the heart's action, either from the anæmia and general feebleness, as from gran-

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\* Treatise on the Diseases of Children, Phil., 1869, p. 455.

† Principles and Practice of Medicine, p. 819.

ulo-fatty degeneration of the muscular fibres of the heart. A case [occurred in my practice, of a girl, eleven years old, who, two weeks after recovery from an attack of diphtheria, attempted to run up stairs, and died in a few moments after reaching the top. Another case in my practice died suddenly from an over-exertion in swinging, shortly after recovering from an attack of diphtheria. Professor Flint refers to two cases in his practice. 6, Suddenly developed passive congestion and œdema of the lungs, probably due to feebleness of the heart's action, or to paralysis of the respiratory muscles. Dr. J. F. Meigs, among others, has reported ‡ cases in which sudden or unexpected death was due to the formation of clots in the right cavities of the heart. A girl, thirteen years old, who was under my care during a very severe attack of diphtheria, made a good recovery, and several weeks afterwards was choked to death by a piece of bread, owing to paralysis of the muscles of deglutition.

#### LOCAL SYMPTOMS.

Very often the first symptom which a child complains of is that the throat feels as though there was a bone or stick in it. This slight soreness or fullness does not ordinarily become any more severe during the course of the disease. The absence or mildness of local symptoms is the main reason why the disease is so often overlooked in its first stages. In numerous instances in my practice, considerable membranous exudations already existed when there had been no manifestation of pain or soreness in the throat. This has taught me to examine the throat of every child whose illness was not otherwise plainly accounted for. The color of the faucial mucous membrane is usually of a deep, bright red, but in other cases it is a dusky red, which indicates a vitiated state of the blood, and is an unfavorable prognostic sign. The submaxillary and cervical glands of the side the most affected soon become swollen and tender, or even painful to moderate pressure, but they are not tense or hard, except in very severe cases. I am inclined to think that the enlargement of the glands is proportionate to the severity and depth

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‡ American Journal of Medical Sciences, April, 1864, p. 305.

of the local lesion. After a few hours in some cases, and in others in the course of a day, isolated specks or patches, whitish or grayish in color, sometimes soon acquiring a yellow tinge, and soft in consistence, make their appearance, and rapidly increase in size, so that by their growth and coalescence, they may cover both tonsils within a day or two. It increases in thickness and opacity coincidently with its extent in surface, becoming darker with age, and with incorporation of the coloring matters of effused blood. Attempts to detach it from the mucous membrane lacerates the engorged blood vessels, producing a free flow of blood. It does not ordinarily attain a greater thickness than one-eighth to one-sixth of an inch. The deposit may remain limited to a circumscribed locality, or it may spread over the entire pharynx; sometimes descending into the larynx, and thence down the trachea and even along the bronchial tubes. When the larynx and trachea are affected, we have the symptoms of membranous croup, superadded to the already alarming condition of the patient. The membrane also mounts upward along the posterior nares, and soon takes possession of the nasal passages, and may even protrude at the nostrils. In some instances the tongue, the gums, and the inside of the cheeks become covered with the characteristic deposit. The deposit remains on the mucous membrane for several days—from three to six in favorable cases. Its separation is promoted by the secretions underneath, especially by pus, which is formed in abundance between it and the surface on which it lies. During the height of the inflammation, it is surprising often to see with what rapidity the diphtheritic membrane returns when removed by force. A few hours often suffice so restore it as firm and extensive as before the interference. The breath in malignant cases is often very offensive, having a gangrenous odor. I have often noticed that the membrane has first formed on the left tonsil or left side of the throat. It occurs also on the surface of the body when the skin has been blistered or abraded, and upon the edges of the wound produced by tracheotomy. In one of my cases the membrane made its appearance first on the

right cheek, where the skin had been abraded. The abraded surface was covered with a whitish membrane, the whole cheek and skin red, swollen and inflamed.

The glands of the neck were very much enlarged. The symptoms of laryngeal implication are hoarseness, cough, and difficulty in breathing. Laryngoscopic examination usually reveals intense congestion and tumefaction of the larynx, more or less of the borders, and interior of which are covered with the exudation. The anatomical character, as regards the larynx and trachea in diphtheria, when they are the seat of fibrinous exudation, is identical with that of croup. Respiration is impeded, the face becomes palid, the lips and nails blue, and the extremities cool. The child struggles for breath, is restless, alarmed, and sometimes clutches at its throat, and exhibits all the evidences of commencing asphyxia. When a portion of the membrane is expectorated by great effort on the part of the child, or by the treatment, there is apparently for some hours a great improvement, but it is only in exceptional cases that the plastic formation is not speedily and fully re-produced. In favorable cases the symptoms show evidence of amelioration from the sixth to the twelfth day. This complication may occur at any period of the disease, or during convalescence. In fact, for several weeks there is a peculiar liability to croup, upon the least exposure to cold and dampness. The *sequelæ* of diphtheria form an important part of clinical history. Where there is a large amount of albumen excreted from the kidneys, there is necessarily impoverishment of the blood. This condition leaves the patient for weeks with a pale and cachectic appearance. The blood evidently is profoundly altered, so that there is a deficiency of blood-disks. Anæmia and general debility are apt to persist a considerable period. Certain specific sequelæ of a nervous character are apt to follow diphtheria, and they are indicative of a profound morbid impression on the nervous system. These are paralysis of certain of the muscles concerned in deglutition and phonation; occasionally of the muscles of the heart; of the eye, causing presbyopia, myopia, and amaurosis; of the limbs and of the

other portions of the body; in some instances amounting to general paralysis. In some the muscles of the bladder have been paralyzed, leading to retention of the urine, and difficulty in passing it. Taste, smelling and hearing are often affected. Laryngeal paralysis, favoring the escape of food into the air passages, necessitate the use of the stomach tube. Numerous cases are mentioned similar to the previously-mentioned case of my own, in which sudden death was caused by the passage of food into the larynx. These sequelæ take place in cases of mild as well as severe diphtheria. A majority of those affected with paralysis recover, although few regain the complete use of their muscles in less than one month, and many do not under several months. Purpura, with an irregular mottling of the skin, with hæmorrhage from various outlets of the body, is also a complication. Cardiac thrombosis is a tolerably frequent complication of diphtheria.\* The elastic fibrinous coagula entwined in the valves, or which adhere to the walls of the heart, are formed before death.

#### TREATMENT.

There is no subject in modern therapeutics upon which medical authorities differ so essentially as in the treatment of diphtheria. It is remarkable that there is so little agreement in the profession in regard to the medicinal treatment of the disease, since it has been under almost constant observation in this country for over twenty years. At first, experimentation and great uncertainty constituted the rule and result of all attempts at treatment, and very many indeed were the missteps which were made before any degree of rational progress had been reached.

During the years of its first appearance, I have no doubt but that much of the fatality of the disease was directly owing to bad treatment—purgatives, leeches, mercurilization, the indiscriminate use of caustics, pustulation with tartar emetic, and croton oil blisters. The wide discrepancy which exists in reference to the proper therapeutic measures, receives par-

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\* Thrombose Cardiaque dans la Diphtherie. Beverly Robinson, M. D., Paris, 1873.

tial explanation from the fact of a wide difference of opinion as to the nature of diphtheria and its mode of commencement, but is more due to the fact that statistics of its treatment afford very unreliable, and often conflicting data by which to determine the proper therapeutic measures. The treatment of diphtheria, like the treatment of most other diseases, is dependent on a multitude of circumstances; on the condition of the patient when seen by the physician—on the peculiar situation in which he may be placed as regards wet or dry localities—on constitutional tendencies, etc. As diphtheria is always serious, every case demands close attention, and frequent and careful examination, with the aid of all the resources at our disposal; and the treatment, to be at all effectual in hazardous cases, must be assiduous and free from vacillation. Diphtheria is a disease that is not controllable by any known specific remedy. Nutritive, supporting and stimulating treatment constitutionally, is now almost universally recognized as absolutely necessary; and depleting measures, even of the mildest character, are almost universally avoided. Several objects must be kept prominently in view during the entire treatment. Chief among these is efficient sustenance of the patient, and the prompt discharge of the morbid products as they accumulate. The diet should be concentrated, highly nutritious, and embracing the necessary variety of alimentary principles. Milk and the animal essences meet these requirements. Strong beef tea, mutton broth, strained oatmeal-gruel with milk, the yolks of eggs, are useful, and should be given at regular intervals, and in as large quantities as the stomach will tolerate. A serious difficulty in the treatment often arises from the great repugnance to nutriment, and sometimes from the persistence of vomiting; then recourse must be had to the absorbing powers of the rectum. One of my patients, three years old, who could not be made to swallow, was treated entirely by the rectum, and recovered. Not only the medicine, but an ounce of beef tea, alternated with cream, was given by enema every four hours, for four days and five nights. For drink, ice water in small quantity at a time; or, if there be much

redness and swelling about the fauces, pounded ice in teaspoonful doses, iced milk, etc. The sick room should be thoroughly aired, and the body and bed clothing should be changed daily when it is possible. There is not the least danger of "catching cold" in bed if the patient is well clothed. The bed should be so situated that the fresh air from out of doors may blow over it and thoroughly dilute the foul air of the room. From the first, although the pulse is strong, the surface hot and features flushed, all measures of a depressing nature must be carefully avoided. The danger is not from the inflammatory manifestations of the disease, but from the general condition which tends to destroy life by asthemia. Cardiac sedatives should not be administered, since diphtheria, if it continues a few days, is attended by evident symptoms of prostration, whatever the mode of commencement. A warm foot-bath, with mustard, will tend to equalize the circulation, and moderate the fever. Sometimes the case is ushered in with nausea and vomiting, and when these troublesome symptoms continue, either the aromatic spirits of ammonia, or from five drops to a half teaspoonful of the following:

R. Chloroform;  
Tinct. opii;  
Spirit camphoræ;  
Spirit ammon. aromat., aa f. ℥iss;  
Creosoti gtt. iij;  
Olei cinnamon, gtt. vii;  
Alcohol f. ℥ij. M.

In a tablespoonful of ice water, should be administered every half hour.

If constipation exist at the same time, a stimulating enema should be employed. Several external applications have been applied with some benefit to the enlarged and tender glands about the neck. Warm camphorated oil, poultices of hops and vinegar, etc., or what is better, a warm wet cloth, folded in a piece of oil silk, should be applied around the neck, and this method of local bathing and sweating continued without intermission until the symptoms are controlled

or entirely give way. Chlorate of potash, and tincture of the chloride of iron, are the two remedies which have been most employed in this country and in Europe, on account of their supposed local effect on the inflamed surface, and the latter on account of its eminently tonic properties. Chlorate of potash was first successfully applied in croup, by Chaussier, in 1819. It was brought prominently into notice by Dr. Isambert, in his inaugural thesis.\* It was then endorsed by Trousseau. Since then it has been used, and good results obtained in diphtheria and pseudo-membranous croup. The use of chlorate of potash in diphtheria and membranous croup has some advantages not possessed by other remedies. All local treatment, except by the solution itself, is unnecessary, for that it has solvent action on the membrane, has been proved by M. Barthez.† Another advantage is that other remedies may be used in connection with it. Dr. Drysdale‡ considers chlorate of potash “quite as much a specific, if we may use such a word, for this disease, as is quinine in intermittents, or mercury in syphilis.” His formula is:

R<sub>y</sub>. Pulv. potassæ chlorate, ʒij;

Syr. limon, fl. ʒi;

Aquæ, fl. ʒiij. M.

On the other hand, Dr. Cohen || doubts its efficacy as a reliable remedy against the disease, or against its local manifestation. Furthermore, its inordinate use may irritate the kidneys, a result to be avoided in view of the significance of albuminuria as an unfavorable manifestation. Preparations of iron, principally the tincture of the chloride of iron, first used for diphtheria by Dr. Vess, of Birmingham, England, is highly extolled for its virtues in this disease. The action of chlorate of potash and iron in diphtheria seems to be both local and general. Locally, it acts as astringent and disin-

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\* Etudes Chimiques, Physiologiques, et Cliniques, sur l'Emploi Thérapeutique du Chlorate de Potasæ, spécialement dans les Affections Diphtériques, Paris, 1856.

† American Journal of Medical Sciences, October, 1858, p. 513.

‡ Medical and Surgical Reporter, March 17, 1877, p. 239.

|| N. Y. Medical Record, March 4, 1876, p. 152.

fectant, causing contraction of the capillaries of the throat, and destroying the life of the diphtheritic exudation. Generally, it acts as a stimulant and disinfectant. By giving oxygen and chlorine to the blood, it stimulates the vital powers, and destroys the poison of diphtheria. Dr. J. Lewis Smith§ considers the following mixture one of the very best for ordinary diphtheria:

R<sub>x</sub>. Tinct. ferri chloridi, ʒi;  
Potass. chlorat, ʒi;  
Syr. simplic, ʒij. M.

Dose—One teaspoonful every two hours to a child of three years. Dr. Rodman, of Frankfort, Ky.,¶ uses the following for a child five years old:

R<sub>x</sub>. Tinct. ferri chloridi;  
Potass. chloratis, āā ʒss.;  
Syrup limonis;  
Aq. destillat. āā ʒij. M.

Dose—One teaspoonful every two hours. The following two formulas are prescribed by Dr. C. E. Billington, of New York, and were used by him in one hundred and seventy-nine cases:

R<sub>x</sub>. Tinct. ferri chloridi, fl. ʒjss;  
Glycerinæ;  
Aquæ, āā fl. ʒj. M.

Dose—One teaspoonful every hour. For children under three years, only one drachm of the tincture of iron in this mixture is sufficient. This combination tastes pleasantly. Dr. Billington, in his first cases, accompanied the above prescription with the following:

R<sub>x</sub>. Potassæ chloratis, ʒss.—ʒj;  
Glycerinæ, fl. ʒss;  
Aquæ calcis, fl. ʒijss. M.

Dose—One teaspoonful every hour. This is given alternately with the preceding one, with half hour intervals between the two. The frequency of the dose is insisted on, except during the night, when the patient is allowed to sleep

§ Diseases of Infancy and Childhood, p. 458.

¶ N. Y. Medical Record, January 26, 1878, p. 62.

an hour or two at a time if he will. Chlorate of potash can be given in the form of lozenges, containing a grain or more of the salt each, administered as frequently as may be necessary to introduce the desired quantity of the chlorate, usually from thirty grains to a drachm or so in the twenty-four hours. Chlorate of potash is frequently used in the form of chlorine mixture, which contains an equal number of grains of the salt, and of drops of muriatic acid in simple or aromatic water; infusion of quassia and the like, with the addition of some syrup, is desirable.

Salicylic acid, which, though found in the willow, is made from carbolic acid, and is a most valuable antiseptic, is being used very extensively in diphtheria. Dr. Letzerich\* made a number of experiments in regard to the action of salicylic acid upon the organisms found in diphtheritic deposits, the result showing that this acid possesses the power of killing the germs in question. In several cases Dr. Letzerich used the following gargle:

R<sub>y</sub>. Acidi salicylici, grs. xv;  
Solve in spts. Vin. Rect. m. xxx;  
Aquæ destillatæ, ad ℥viii. M.

Under the frequent use of this gargle, the diphtheritic membrane disappeared from the throat entirely in from two to four days. In very severe cases four and a half grains of the powder, with an equal quantity of sugar were administered every two hours. Dr. Billington, of New York, in his later cases, instead of his mixture of chlorate of potash, has used the following:

R<sub>y</sub>. Acidi salicylici, gr. x.—℥j;  
Sodæ sulphitis, ℥ss.—℥j;  
Glycerinæ, fl. ℥ss;  
Aquæ, fl. ℥ijss. M.

Dose—One teaspoonful every hour, alternating at half-hour intervals, with the iron mixture. The sulphite of soda is used to dissolve the salicylic acid. Theoretically the combination of two such septicides should be especially effective. A writer in the *Pharmaceutische Zeitung*, for November,

\* Canada Lancet, March, 1878, p. 221.

1875, states that four grains of salicylic acid will prevent the development of fungi in three pounds of fresh lime juice. A trial made under similar conditions without salicylic acid resulted in the formation of mold in ten days. Dr. Wagner, of Freiburg, Germany, gives salicylic acid in water or wine, one and one-half to four and one-half grains every two hours. He reports fifteen cases of diphtheria cured by this method. Alcohol has been used very extensively in diphtheria. Dr. E. N. Chapman, of Brooklyn, N. Y.,† says: "Alcohol counteracts, neutralizes or destroys the poison, whatever it may be, acting, in fact, like a true antidote, if promptly and liberally given." On the other hand, Dr. C. E. Billington, of New York, says:‡ "Stimulants should not be indiscriminately used in diphtheria. I have treated the great majority of cases without them, and believe this to have been an important element of my success. When unnecessarily or excessively employed they may be very injurious." M. Sanné, in his treatise on diphtheria, says: "De tous les antiseptiques données à l'intérieur, l'alcool est de beaucoup le plus sur. Plus l'infection est prononcée, plus il faut insister sur les composés alcooliques." Under ordinary conditions, alcohol is a stimulant; but in diphtheria it lacks this property—a quantity which would in health induce intoxication having no excitant effect; it is thrown off in the breath; but in diphtheria, unless the dose is disproportionately large, no odor is perceptible until the disease begins to yield. Dr. J. Léwis Smith, of New York,|| reports a case in which nearly a bottle of brandy was given in less than twenty-four hours, without any ill effect, and an apparent good result on the general course of the disease. In the use of alcoholic stimulants the physician is to be guided by the indications, and by carefully watching the immediate effects.

Professor Polli, of Milan, advocates the use of the sulphites, in the belief that the sulphurous acid set free in the system by their decomposition, prevents, or tends to pre-

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† Buffalo Medical and Surgical Journal, October, 1877.

‡ Diphtheria and its Treatment, New York, 1876, p. 15.

|| American Journal of Medical Sciences, October, 1877, p. 352.

vent, the supposed fermentative processes going on in the economy, and by this means to ameliorate, if not entirely control the morbid action. Experiments have shown that this agent does check fermentation without the system, and the theory of Polli possesses a degree of plausibility. The most eligible of the sulphites is the bisulphite of soda, since this gives a large amount of sulphurous acid, and has no purgative effect, like some of the sulphites. The following formula is given by Professor J. Lewis Smith:

Rx. Sodæ bisulphit, ʒj—ij;  
Tinct. aurant, ʒij;  
Aqua, ʒx. M.

Dose—One teaspoonful every two hours. Quinia is much used as a tonic in diphtheria, as well as for its action upon the nervous system, and as an apyretic in fever. It may be combined with the tincture of iron in the form of the hydrochlorate; or, if that is not accessible, in the usual form of sulphate. Dr. Zum Sande, of Lingen, § believes that nothing is so successful as quinine to add to the blood some material which would prevent the development of organisms. There is great difference of opinion in regard to the quantity which is required each day, or the size and frequency of the doses. It is sometimes administered in small doses, as one grain every three or four hours, for its supposed tonic effect; and again in doses sufficiently large to produce an antipyretic effect, as from twenty to forty grains per day. I believe that quinine, as a rule, in the case of young children, is worse than useless. By its bitterness, it causes frequent struggles and crying, and nervous irritation, febrile excitement and exhaustion, are frequently promoted. Dr. Billington has seen cases where the struggling and crying has caused diphtheretic material or irritating medicine to be drawn into the larynx, thus setting up croup. I consider the compound tincture of cinchona much better as a tonic. Cubebs was first brought forward as a remedy by Dr. Trideau, of Andoville, France, ¶ who reported twenty-six cases cured by its use. Dr. C.

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§ Journal fur Kinderkrankheiten, August, 1871.

¶ Bulletin General de Therapeutique.

Paul, of Paris, had an extract of cubebs, made with water, alcohol and ether prepared, and mixed one part of this with seven of sugar, and one of gum arabic. A teaspoonful of this, containing twenty-five grammes of extract, dissolved in three or four tablespoonfuls of water, made a sweet aromatic solution, which was taken by the child without repugnance. One severe case was treated almost entirely with this remedy. This treatment has received the commendation of many observers, who followed Trideau in its use. It is supposed that the elimination of this remedy by respiratory tract enables it to exert a special topical influence on the bronchial mucous membrane. The hyposulphate of soda has been used internally, in the hope that in its decomposition the system may be favorably subjected to the influence of sulphurous acid upon low organisms. It is administered in doses of from one to three grains to children, and from eight to ten grains to adults, repeated every three or four hours. Dr. Burton, of Fultonville, New York,\* used it with remarkable success. I have treated one hundred and thirty-three cases with the tincture of the chloride of iron and chlorate of potash, ten to twenty drops of the one and three to six grains of the other, given in mixture every four hours, diluted with water. Alternating with the above, I used in many cases the sulpho-carbolate of soda, in doses of five to fifteen grains every four hours. In more recent cases, in addition to the above, or in place of the sulpho-carbolate of soda, I have used the following:

R<sub>x</sub>. Fl. ext. Pinus Canadensis, ℥ij;  
Aquæ fervens, ℥iv. M.

Dose—One teaspoonful as a gargle, when patient was old enough, after which let the patient swallow one teaspoonful. Use in this way every hour. Where there is great nervous irritability and sleeplessness, I give:

R<sub>x</sub>. Tinct. gelseminum, gtt. x.—xxx;  
Aquæ, ℥ij.—iv. M.

Dose—One teaspoonful every two or three hours. Tepid baths were also given. As a diet, milk or milk punch, as

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\* Buffalo Medical and Surgical Journal, September, 1877.

much as the stomach will retain. Whenever practicable, I use the following, applied to the throat in the form of a spray:

R. Acidi carbolici, m. xv;  
Aquæ calcis, fl. ʒ vj. M.

The early and thorough use of the nasal syringe, I believe has saved many cases. The nasal passages and pharynx should be thoroughly cleansed; first with tepid salt water, and then one or two syringe-fuls in each nostril of the above mixture.

In one hundred and thirty-three cases of diphtheria in my practice during a period of nine months, one hundred and fifteen recovered, and eighteen died. In regard to the period of incubation, in eighty cases I have been able to approximate closely the day of exposure. In them I found the extremes to be two and fourteen days; the mean,  $5\frac{2}{3}$ . Of those under twenty, the mean was  $4\frac{3}{4}$ ; over twenty,  $7\frac{1}{3}$  days. Of those attacked, two years old and under, 10 males and 13 females; from 3 to 10, 42 males, 48 females; from 11 to 20, 2 males, 10 females; over 20, 3 males, 5 females. Total, 57 males, 76 females. The male cases ending in recovery had an average continuance of seven days; ending in death five days, while the female cases recovering averaged eight, and those dying ten days.

Of the eighteen who died under my care, six were either moribund when first seen, or were hopeless cases of laryngeal croup, and were seen only once or twice before death. In addition to the eighteen deaths, four others died; one from getting choked with a piece of bread, two from anæmia, and one from uræmia, from one to three months after the recovery from diphtheria. In the town of Meriden there were altogether one hundred and nineteen deaths from diphtheria during the epidemic of 1875-6. In the epidemic of 1862-3 there were seventy-three deaths in Meriden from diphtheria.

#### LOCAL TREATMENT.

With regard to the treatment of the local manifestations, there is great difference of opinion. Many eminent practitioners discard all local treatment whatever. A physician

recently recommended\* nitrate of silver, one-half ounce, to one ounce and a half of water, to be applied by a sponge. If this did not remove the membrane, then use muriatic acid or nitric acid and honey, equal parts. He says: "We should at least have two assistants, so as to hold the head well thrown back, and the hands and feet secured." This treatment is simply barbarous. The pain and restlessness caused by such treatment weakens the child, and does more harm than good. Harshness towards a patient is always to be condemned, and in no disease more than this. Dr. W. M. Turner, of Petersburg, Va.,† says: "I studiously avoid probangs; I look upon them as instruments of torture and of death. I *know* I have seen cases which died from the constant mopping to which the throat was subjected." Local treatment was employed by Aretæus, centuries ago, and then re-introduced into practice by Von Swieten, and again by Bretonneau; it has been abandoned and resumed again and again. When applications are made, they should be made either with a large camel's hair pencil, or, what is better for most of the mixtures employed, with the atomizer. Tincture of the chloride of iron, first recommended by Dr. Heslop, of Birmingham, England,‡ and by Drs. Gigot and Jodin,|| is at present the favorite topical remedy with most practitioners.

The sulphate of iron (Monsel's salt) in powder, has been found the most efficacious remedy by some practitioners.§ Nitrate of silver, as a local remedy, was first recommended by Dr. Mackenzie, of Glasgow.¶ It has been highly recommended by Bretonneau, Trousseau and many others, but of late years it has lost its repute. Dr. J. F. Sullivan, of San Francisco, treated over four hundred cases of diphtheria with a solution of nitrate of silver, in the proportion of a drachm of the salt to an ounce of distilled water. The applications were made with a sponge probang. Dr. J. Lewis Smith, of

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\* Philadelphia Medical and Surgical Reporter, January 27, 1877, p. 75.

† American Medical Times, December 8, 1860.

‡ Medical Times and Gazette, 1858, p. 552.

|| Gazette des Hop., 1858, p. 359.

§ New York Medical Journal, January, 1874, p. 84.

¶ Edinburgh Medical and Surgical Journal, 1825, p. 294.

New York, recommends carbolic acid as a local application to be applied by a large camel's hair pencil:

R<sub>y</sub>. Acid carbolic, gtt. viij;  
 Liq. ferri subsulphat, ℥ij.—iij;  
 Glycerinæ, ℥j. M.

Dr. F. C. Hotz, of Chicago,\*\* speaks very highly of the following as a topical remedy in diphtheria:

R<sub>y</sub>. Acid carbolic cryst.;  
 Alcohol, aa ℥j;  
 Aquæ, ℥v;  
 Tinct. iodin, ℥ss. M.

This makes a perfectly clear, transparent mixture, of a brown red color, which soon, however, passes into a pale yellow. The local application of powdered sulphur has been highly lauded, especially by Spanish authorities, for its destructive action upon low organisms. Dr. J. Ullersperger†† speaks highly of sulphur in diphtheria. He prefers the unwashed flowers of sulphur, on account of the presence of some sulphuric acid. Sulphur has been recommended as a local application; but being quite insoluble, can have no curative effect, and must only act as an irritant, like marble dust. The solution of chloride of soda (U. S. P.) is a useful local application in malignant cases, especially where there is fetor from the breath. Another remedy which I have found useful to neutralize the odors from the mouth, is the following:

R<sub>y</sub>. Permanganate of potash, grs. x;  
 Aquæ distill., ℥j. M.

S. One teaspoonful to a tumbler of water, to be used as a mouth wash.

Dr. Souley‡‡ speaks of the great utility of phenicated camphor as a local application. With this preparation he has seen the pseudo-membrane lose its vitality, without any irritation of the surrounding parts. The solution is prepared by dissolving powdered camphor in crystalized carbolic acid, previously dissolved in alcohol (nine parts of the acid and one

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\*\* Chicago Medical Journal, July, 1871.

†† Journal für Kinderkrankheiten, vol. 5 and 6, May and June, 1868.

‡‡ Gazette Hebdom, November 23, 1877.

of alcohol), and which may be employed either in its pure state, or mixed with equal parts of sweet almond oil. The atomizer has proved of great benefit in many cases that I have treated. With this, solutions of alum, borax, chlorate of potash, lactic acid, carbolic acid, sulphurous acid, bromine, glycerine, creosote, iodine and the like can be employed, where it would be impossible to use a brush or probang. In one of my cases, twelve years old, I used a solution containing five per cent. of tannin, each inhalation lasting from fifteen to twenty minutes. After several repetitions of this, large pieces of false membrane were ejected, and the breathing relieved. Dr. C. Edel, of New York, ||| has met with good success in a number of cases, by adding fifteen drops of the oil of turpentine to the boiler of Tiemann's steam atomizer, half filled with water. Dr. J. W. Curran relates in the *London Lancet* of losing a number of cases of diphtheria, which we do not wonder at when we read of his treatment, which consisted principally of calomel and blisters. Finally he began to use inhalations of iodine in hot vinegar and sage, and saved every case. Dr. G. H. Eyster §§ says: "The success I have met with in the use of iodine inhalations has been most striking. In a very considerable number of cases of well-marked diphtheria, speedy and marked improvement followed every one." Dr. Zwingenberg, of Brandenburg, ¶¶ treated all his cases during a severe epidemic of diphtheria, with alcoholic gargles, without losing a case; and Dr. Hofendahl, of Boston,\* speaks very highly of this treatment in his own experience.

Dr. J. E. Reeves, of Wheeling, W. Va., has used the following with good success, with the atomizer, every hour or two when the patient is awake:

R. Potass. chlorat, ʒij;  
 Acid hydrochloric, puri ʒjss.;  
 Aquæ, ʒvij;  
 Tinct. ferri chloridi, ʒj. M.

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||| New York Medical Record, January 19, 1878, p. 50.

§§ American Practitioner, May, 1871.

¶¶ Allgem. Hom. Zeitung, vol. 77, No. 1.

\* N. E. Medical Gazette, March, 1869.

Dr. J. Lewis Smith † is in the habit of using the following mixtures with the atomizer :

- R<sub>x</sub>. Acid salicylic, ℥ss.;  
Glycerinæ, ℥ij;  
Aq. calcis, ℥viij. M.
- R<sub>x</sub>. Acid carbolic, gtt. xxxii;  
Glycerinæ, ℥ij;  
Aqua calcis, ℥vj. M.
- R<sub>x</sub>. Acid carbolic, gtt. xxxii;  
Potass. chlorat, ℥ij;  
Glycerinæ, ℥ij;  
Aqua, ℥v. M.

#### TREATMENT OF CROUP.

When croup appears we must change our treatment materially to oppose that dangerous complication. Under the measures of treatment heretofore relied on, this complication has proved fatal in the vast majority of cases. Emetics have been and are still employed in the treatment of this disease. The action of an emetic is to induce diaphoresis of the skin from the vascular relaxation which accompanies the act, and something of the same kind may be supposed to take place in the bronchial mucous membrane, thus facilitating the detachment of viscid and adherent secretions. For children under three years of age, ipecacuanha is preferable. Professor Meigs, of Philadelphia, recommends alum highly, a teaspoonful in an equal quantity of honey or molasses, and repeated in ten or fifteen minutes if the first dose is ineffectual. Antimony, turpeth mineral or any of the depressing emetics, are not advisable in this form of croup. Professor J. Lewis Smith recommends highly the following :

- R<sub>x</sub>. Potass. chlorat, ℥ij;  
Ammon. muriat., ℥ij;  
Syr. simplic, ℥j;  
Aqua, ℥ij. M.

One teaspoonful every twenty minutes to a half hour; or, in cases not severe, every two hours. A warm, moist atmos-

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† American Journal of Medical Sciences, October, 1877.

phere is of the greatest importance, and the atmosphere of the room should be charged with as much vapor from boiling water as possible. Professor Lewis A. Sayre, of New York, attributes more importance to this than to any other remedial measure. Professor Smith says that in one of the most severe cases he ever met, which terminated favorably, the room was so filled with steam that water hung in drops from the ceiling. The atmosphere which the child breathes should be constantly loaded with moisture, without, however, that degree of heat which would add materially to the discomfort of the patient or attendants. Lime or vinegar may be added to the water. One of the most severe cases of diphtheritic croup that I ever attended was saved by the thorough use of steam. There was stridulous, labored breathing, with marked depression over the clavicles at each inspiration. The aphonia was complete. There was capillary congestion, and it seemed every moment that the child, who was six years old, would breath her last. With the aid of intelligent attendants, the temperature was kept at  $90^{\circ}$ , and the room saturated with steam. Muriate of ammonia, combined with chlorate of potash, was given internally. At the beginning of the fourth day the membrane had disappeared from both tonsils, and the symptoms were very much better. At this point, with that regard which some persons seem to have for their physician, I was dismissed, a homœopathic physician was called in, and I suppose took all of the credit for curing the child. In another case, where the child, four years old, had been kept in a room saturated with steam for three days, and the symptoms were so much better that I considered the child almost out of danger, the parents, who were extraordinary specimens of perverse stupidity, at the suggestion of some neighbors, removed the steam from the room, dosed the child with goose oil, and in ten hours she was dead. The most experienced physicians regard the inhalation of steam to be more useful than all other measures combined.

## TRACHEOTOMY.

If all remedies fail and suffocation seems inevitable, there is yet one measure which offers a slight hope of restoring life—opening the trachea, and inserting a tube through which the patient may breathe. The operation is generally unsuccessful, on account of the desperate condition of the patient before it is resorted to. When it is resorted to early, while there is yet a reasonable amount of strength, there is a great deal more to be hoped for from the operation. If it is delayed until the pulse has become feeble and frequent or gone at the wrist, the surface cold and blue, there will have been prolonged congestion of the arterial side of the lungs and the right side of the heart; which the greater degree of exhaustion will compromise the chances of success very much, and there will be more likelihood of a bronchitis or pneumonia being developed, which will pretty certainly prove fatal. The propriety of the operation appears to be generally conceded in France and Germany. Most New York surgeons seem to shun the operation, and regard it with ill favor. In 1,249 cases recorded by Dr. A. L. Voss,\* only 294 recovered. Dr. Kroenlin† gives a statistical report of 567 cases of diphtheria which came under the care of Professor Von Langenbeck. Of these, 379 died, while 190 recovered. Tracheotomy was performed 504 times; of these, 357 died. Professor Jacobi, of New York,‡ reports 166 cases operated on by himself and Drs. Krackomizer and Voss. Of these, 127 died, and 39 recovered. No one will deny, in the light of statistics, that tracheotomy is in certain cases proper, and should be resorted to where death is threatened by suffocation from obstruction in the larynx. Dr. W. H. Quill|| considers it incumbent on the surgeon to perform the operation, even though the chance of ultimate recovery be infinitesimal.

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\* New York Journal of Medicine, January, 1860.

† Archiv. für Klin. Chirurgie, 1877, bd. XXI., September 2.

‡ American Journal of Obstetrics, May, 1868.

|| Medical Press and Circular, January, 1878.

## PREVENTION.

No amount of artificial disinfection can ever take the place of pure air, good water and proper drainage, which can not be gained without prompt and efficient removal of all filth, whether from slaughter-houses, etc., public buildings, crowded tenements, or private residences. The most wide-spread evil in many towns is dampness of soil, arising from incomplete drainage; that is, removal of water from the soil. In my own experience the greatest fatality occurred in those houses that were built upon filled land, where the subsoil was clay and the cellars were wet. A large part of the filth in the majority of towns contaminates the air and the soil, and often the water which is used for domestic purposes, by being thrown upon the surface of the ground, or collected in loose walled vaults and cesspools.

The evil sometimes appears in a different form when filth finds its way into small streams. The majority of householders of the present time grossly neglect one or the other of these matters, thereby incurring great risk of bringing disease and death into their families. When there is an epidemic of diphtheria the tendency to mouth catarrh, caries of teeth, pharyngeal and nasal catarrh, congenital and acquired enlargement of tonsils, exposure to cold air, inhalations of dust, cauterization, are just as many invitations to the diphtheritic poison. The patient suffering from diphtheria should be placed in a separate room, and no person except the physician, nurse, and in case of a child, the mother, allowed to enter the room or touch the bedding or clothing used there, until they have been thoroughly disinfected. All clothing, bedding, carpets, or other articles not absolutely necessary for the use of the patient, should be removed from the room before he enters it, and all articles used about the patient, as sheets, pillow-cases, blankets and clothes, must not be removed from the sick room until they have been disinfected. The ceilings and side walls of the sick room, after the removal of the patient, should be fumigated, cleaned and whitewashed, and the wood-work and floor thoroughly scrubbed with soap and hot water. In the case of all children in the family

beside the one attacked, the skin should be washed each day with lukewarm carbolic wash of the strength of Squibbs' two per cent. disinfectant solution of the mixed phenols. A gargle of chlorate of potash, three grains; tincture of the chloride of iron, three drops; water, three drachms; should be used frequently in the mouth and about the nostrils, and the same amount internally every three hours. After one or two days the potash and the iron can be detected in the secretions.

The best way to fumigate a room when not occupied by a patient, is to take in an earthen or wooden vessel four pounds of chloride of lime; moisten it with water, and add thereto a pint of muriatic acid. Chlorine gas is rapidly generated and permeates every article. Keep the room closed for an hour or two, and then thoroughly ventilate it. Water-closets and privies, drains and foul places in houses, stables or yards, should be disinfected daily with the following mixture, which is also useful to soak sheets, pillow-cases, blankets or clothes. Prepare in a tub, sulphate of zinc, eight ounces; carbolic acid, one ounce; water, three gallons.



